

ITC Residential Tower at AJC Bose Road, Kolkata

GRIHA Summit 2014

16th January, 2014

Minni Sastry, Fellow, TERI



ITC Residential Tower - Brief

- High Rise Residential Tower for Senior Managers in Kolkata on 1 Acre of plot in the heart of the city at Junction of AJC Bose Road & Gokhale Road
- 24 floors, 44 apartments,
- Second floor houses recreational activities
- Basement, Ground and First Floor for Parking



Green Residential Tower in Warm-Humid Climate zone of Kolkata

Opportunities Available

Urban Outdoor thermal Environment

- Higher Wind speeds
- Uninterrupted solar radiation



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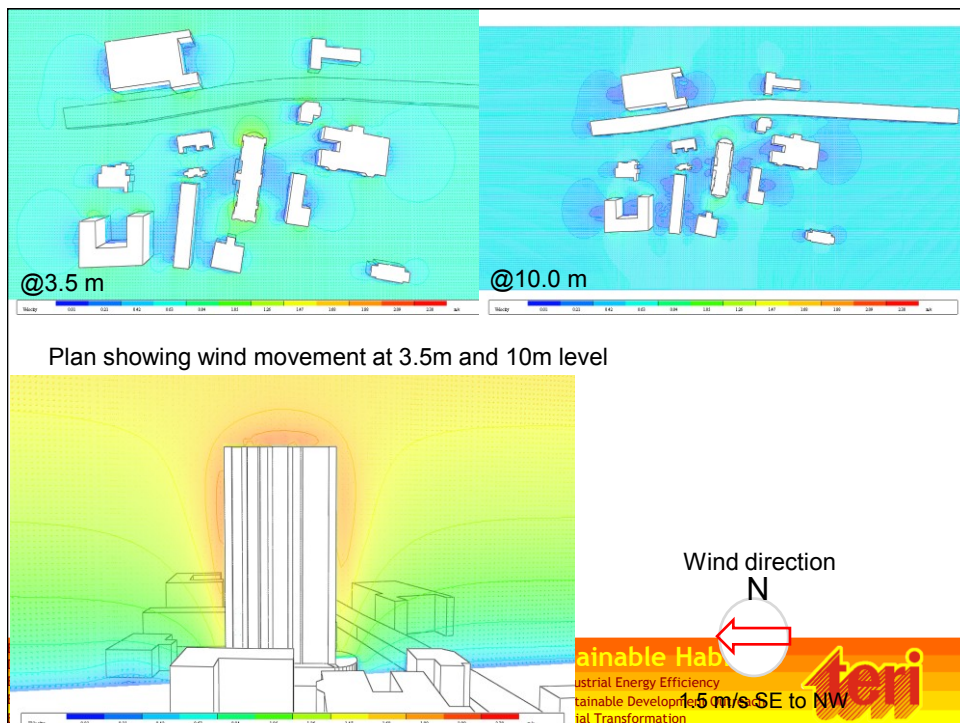
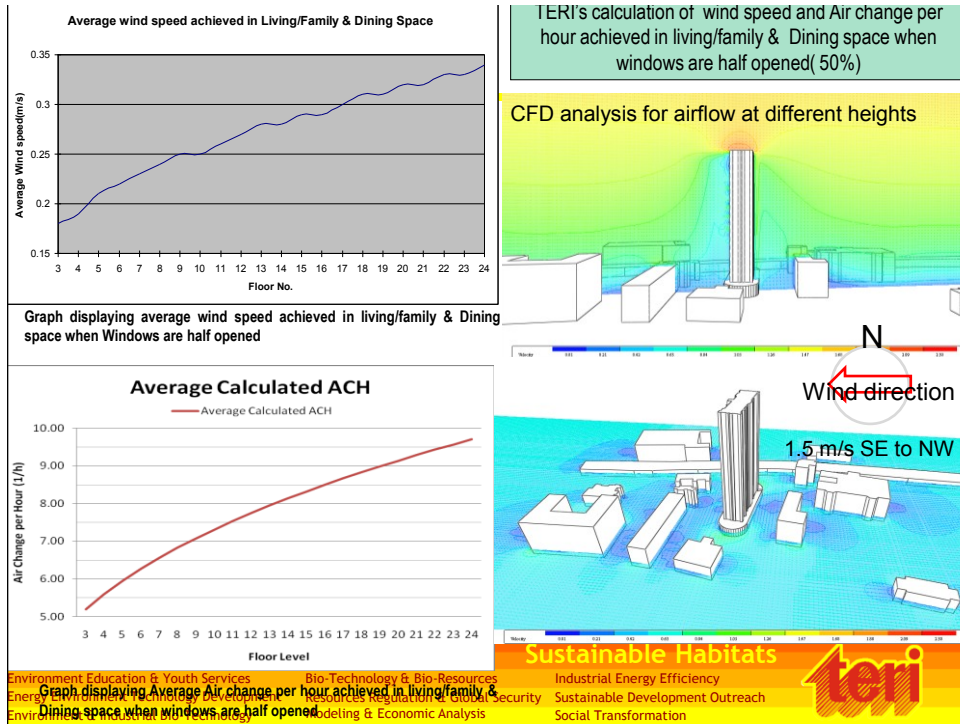
Wind flow analysis for natural ventilation

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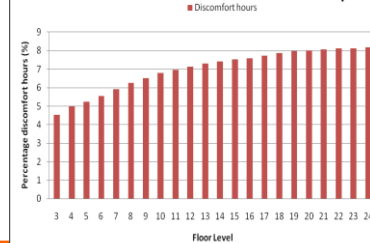
Thermal performance of High Rise Tower in Naturally Ventilation Mode

TERI's analysis of thermal performance of living/family & dining space due to cross ventilation when windows are 50% opened. Discomfort hours achieved are as follows:

FLOOR LEVEL	MODIFIED WINDOW OPENING WITH HEIGHT 2.4 M AND VARYING WIDTH OF OPENING	WIDTH m	AREA sq.m	% OF AREA AS AGAINST BASECASE
24th Floor		0.207	0.497	5.9
12th Floor		0.259	0.623	7.4
3rd Floor		0.387	0.929	11.1

Dry bulb temperature (deg C)	Relative humidity (%)						
	30	40	50	60	70	80	90
28	*	*	*	*	*	*	*
29	*	*	*	*	*	0.06	0.19
30	*	*	*	0.06	0.24	0.53	0.85
31	*	0.06	0.24	0.53	1.04	1.47	2.10
32	0.20	0.46	0.94	1.59	2.26	3.04	**
33	0.77	1.36	2.12	3.00	**	**	**

Total annual discomfort hours at 24 hours occupancy



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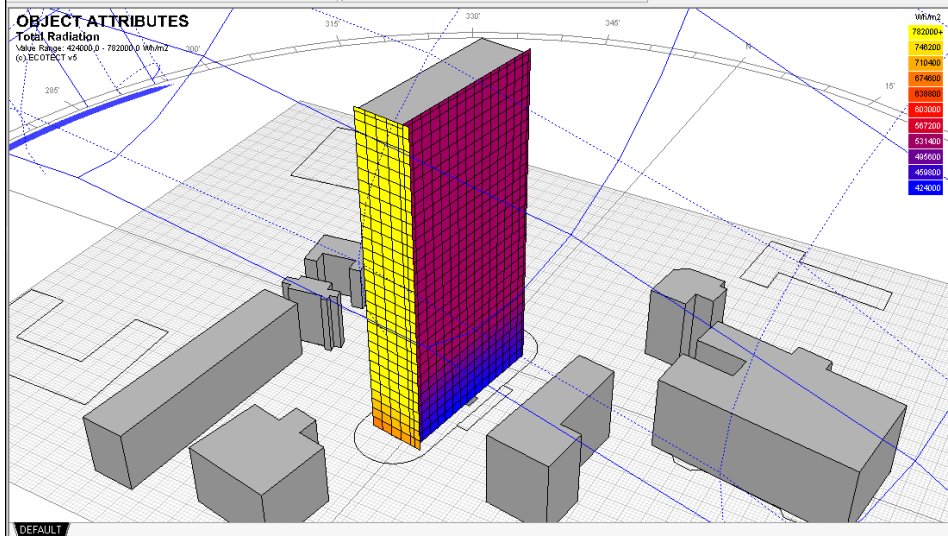
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Solar Irradiation Analysis



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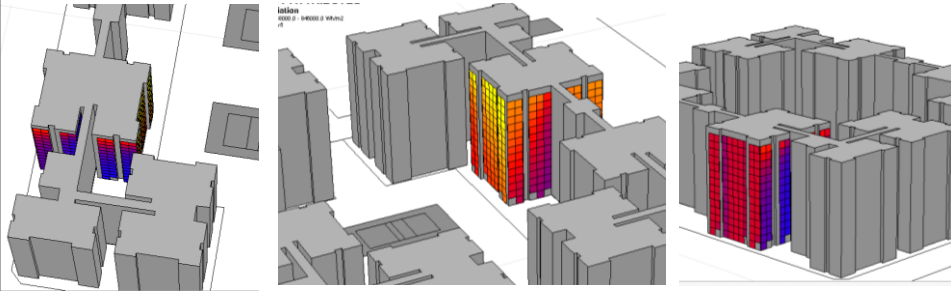
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Residential Township

☉ Solar irradiation analysis - high rise dense development



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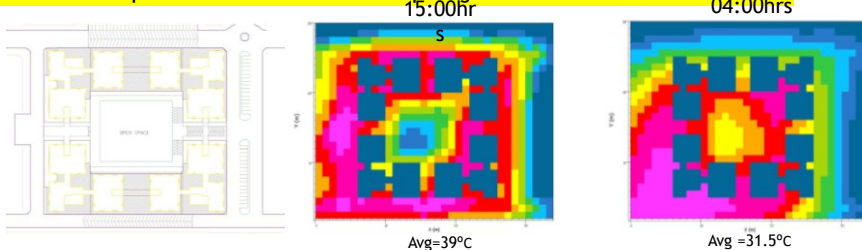
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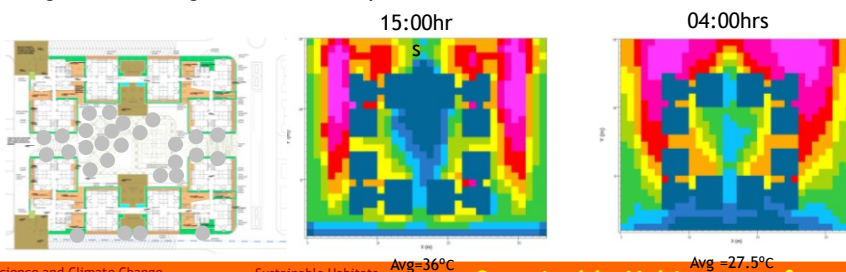


UHI Study- Air Temperature at 1.2m lvl on a typical day during March

Base Case- Asphalt Roads & Cement concrete paving



Design Case- with vegetation and landscape elements recommended



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Adding vegetation and landscape elements reduces air temperature by 3 to 4 deg.C

GRIHA Criteria During Construction Phase

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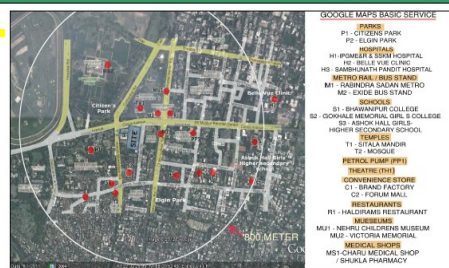


Criteria 1: Site selection

Commitment 1: Document to prove conformity to the development plan/master plan/UDPF guidelines.



Abutting AJC Bose road has a fly over to the north of the site.



BASIC SERVICES/ UTILITIES AROUND 800m OF PROPOSED RESIDENTIAL PROJECT SITE



METRO RAIL & BUS ROUTE CONNECTIVITY FROM PROPOSED RESIDENTIAL PROJECT

Commitment 2: The selected site should be located within ½ km radius of an existing bus stop, commuter rail, light rail or metro station and/ or select Brownfield site (to rehabilitate damaged sites where development is hindered by environmental contamination, thereby reducing pressure on undeveloped land).

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Criteria 2: Preserve and protect landscape during construction (Contd.)

Commitments:

Proper time of construction

Stage & Spill prevention plan

Top soil stabilization methods during construction.



Soil in the central part of the site



North side of the site has an existing swimming pool



Top 200mm top soil removal from site



Top soil unloaded at storage site



Soil stabilization by vegetation on clean soil



Top Soil transportation to storage site

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Temporary Drainage to drain out pile water to sedimentation tank



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Criteria 2: Preserve and protect landscape during construction (Contd.)

Commitment 4: ITC must specify and limit construction activities in pre-planned/designated areas in order to protect other areas of the footprint of the building.



Commitment 5: ITC must ensure to preserve existing mature trees on-site during the course of construction by preserving and transplanting them.

Commitment 6: In the process of construction, ITC must commit to compensate the loss of trees on-site by replanting the same native and of similar size which existed on the site before elimination.



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Criteria 3: Soil conservation (till post-construction)

Commitment 1:

ITC must ensure adequate fertility of the soil to support vegetative growth in the landscape area of the site.

Commitment 2:

Ensure adequate topsoil laying for vegetative growth.

Commitment 3:

Ensure stabilization of soil in areas where the topsoil is vulnerable to erosion.

INDIAN INSTITUTE OF TECHNOLOGY
Kharagpur-721302, INDIA
MURDAI DEVELOPMENT CENTRE
Dr. S. C. Mahapatra
Associate Professor
Date: April 23, 2010

Soil Analysis (Chemical) Report

Soil samples collected from A. J. C. Bose road, housing project site of ITC Limited, Kolkata and sent by Pacific Engineers for chemical analysis. The samples were received on 20/04/2010. The analyzed reports are as follows:

Sample No.	Available Nitrogen (kg/ha)	Available Phosphorus (kg/ha)	Available Potassium (kg/ha)	Organic Carbon (%)	pH
S ₁	231.62	11.6	506.0	0.542	7.86
S ₂	240.48	100.6	428.0	1.44	7.74
S ₃	285.06	19.4	107.0	1.20	7.62
S ₄	277.20	46.2	277.0	0.537	7.75
S ₅	279.97	46.2	230.0	0.699	7.77
S ₆	291.08	19.6	277.0	0.857	7.64
S ₇	449.69	114.4	770.0	0.685	8.01
S ₈	185.72	118.0	506.0	0.699	7.89
S ₉	177.40	113.2	528.0	0.657	7.86
S ₁₀	199.58	90.8	404.0	0.785	8.06

To:
Mr. N. S. Bose, Head-Projects
For Pacific Engineers
131, Sankar Bose Lane, Block B Co. Floor
Saltia, Howrah - 711106

(S. C. Mahapatra)

Dr. S. C. Mahapatra
Associate Professor
MURDAI DEVELOPMENT CENTRE

Soil test report furnished by ITC

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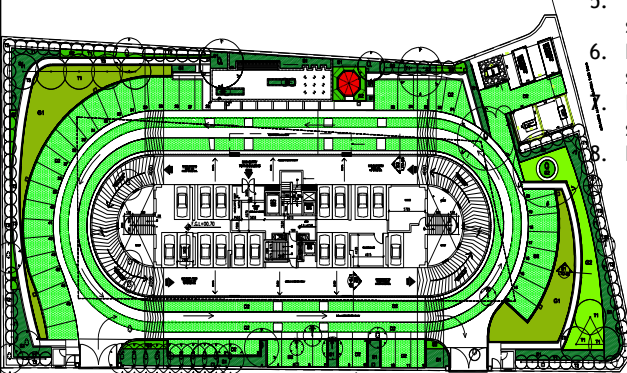
Criteria 5: Reduce hard paving on-site and/or provide shaded hard paved surfaces

Commitment 1:

Total paved area of the site under parking, roads, paths or any other use should not exceed 25% of the site area or net imperviousness of the site not to exceed the imperviousness factor as prescribed by the NBC 2005 (BIS 2005b), whichever is more stringent.

Areas Statement

1. Total site area = 4412.79 sq.m
2. Total built up area = 4358.00 sq.m
3. Ground coverage = 1329.66 sq.m
4. Net site area = 3083.13 sq.m
5. Total paved area = 2031.49 sq.m
6. Pervious paving = 1148.78 sq.m
7. Impervious paving = 882.71 sq.m
8. Net Paved area(%) = 28.63 %



Criteria 8: Provide minimum level of sanitation/safety facilities for construction workers

Comply with the safety procedures, norms and guidelines (as applicable) as outlined in NBC 2005. Adopt additional best practices and prescribed norms as in NBC 2005 (BIS 2005).

Safety Practices at Site



Safety Talk



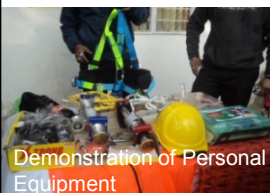
Safety Month Celebration



Safety Training



Safety Patrolling



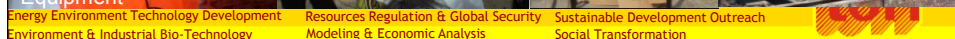
Demonstration of Personal Equipment



Fire Extinguishers site



Machine Guarding



EHS Display and Signage at Site



FIRE EXTINGUISHERS IN SITE		
SL NO	LOCATION OF FIRE EXTINGUISHERS	TYPE OF FIRE EXTINGUISHERS
1	IN FRONT OF LAB OFFICE AND QUALITY ROOM	DCP-2 No-5kg CO-1 No-4.5kg
2	DIESEL GENERATOR AND DIESEL SHED	DCP-2 No-5kg CO-1 No-4.5kg
3	TIME OFFICE	CO-1 No-4.5kg
4	IN FRONT OF ITC OFFICE	CO-2 No-4.5kg



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Labour Colony

Commitment 3: Provide clean drinking water to all workers. **Commitment 4:** Provide adequate number of decentralized latrines and urinals to construction workers.



Labour Houses



Toilets



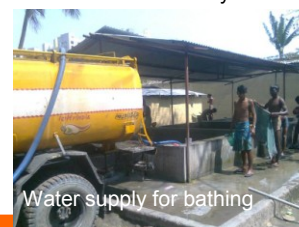
Bath at Labour colony



Drinking-Water at Labour colony



Drinking-Water at site



Water supply for bathing

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Design Phase

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Criteria 11 Reduce water use in the building

Commitment : Reduce the total water consumption in the building (by 25% or more) by using conventional high flow fixtures.

Bathtub Spout, flow rate = 8lpm



Swinging Arm Basin Mixer (Kitchen)



Bib Cock (flow rate = 6lpm)



Concealed Cistern - 9/4.5 litre/flush



Single Lever Basin Mixer
GA Series with Flowrate = 6lpm



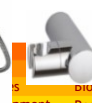
Health Faucet with Angular Stop Cock (ASC)
GB Series with Flowrate = 8lpm



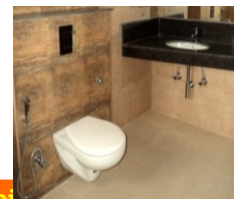
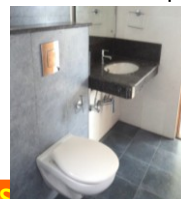
Exposed Cistern



Rain shower & hand shower tube - flow rate = 8lpm



Interior photos of installation



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GRIHA - Sustainable Architecture

Criteria 13: Optimize Building Design to Reduce Conventional Energy Demand

13.1 Commitment

- 13.1.1 Appropriate climate responsive design strategies should be adopted such as: orientation, placement of fenestration and buffer zones, shading devices.
- 13.1.2 Window Wall Ratio (WWR) to be limited to maximum 60%, and Skylight Roof Ratio (SRR) to be limited to a max of 5%.
- 13.1.3 Demonstrate that the effective Solar Heat Gain Coefficient (SHGC) is compliant with the maximum SHGC prescribed by ECBC-2007.
- Ensure daylight area is $\geq 25\%$. Every 25% increase in daylight area – upto a maximum of 75%– shall fetch one additional point.



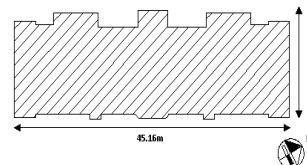
Criteria 13: Optimize building design to reduce conventional energy demand

Commitments achieved :

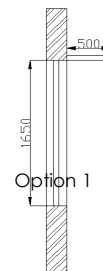
1. WWR - 26%

1. Due to Site constraints East West long façade with deep balconies to shade windows.

1. Glass SHGC 0.45 along with deep balconies helped achieve Net SHGC = 0.25.



Shading Device Design for Air Conditioned Bedrooms

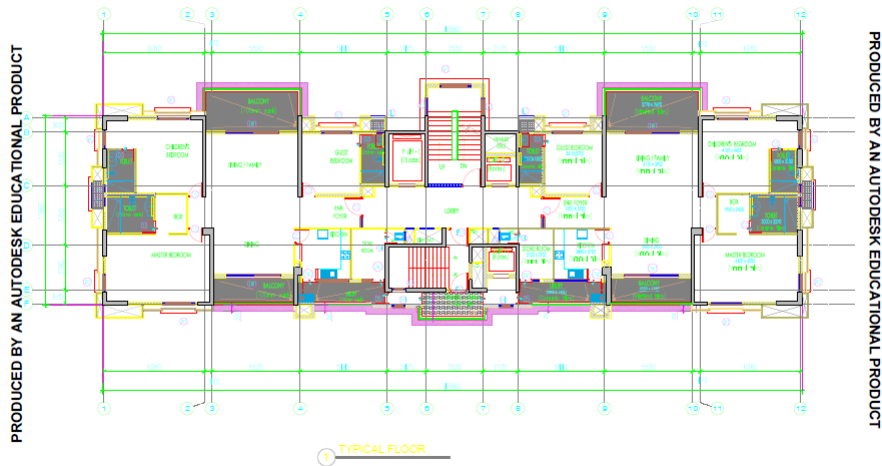


Length of the projection on East facade is	1750mm
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Length of the projection on West facade is	2670mm
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Typical Floor Plan



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100% Naturally Day lit Spaces



DF (Daylight Factor) in various spaces					
Space		DF (Recommended as per BIS)	DF (Achieved)	Glass VLT considered	Daylight area %
North Side Apartment	Children Bedroom	0.625	0.93	39%	100
	Guest Bedroom	0.625	1.12	39%	100
	Living/Dining	0.625	0.64	65%	100
	Master Bedroom	0.625	0.77	39%	100
	Kitchen	2.5	2.57	70%	100

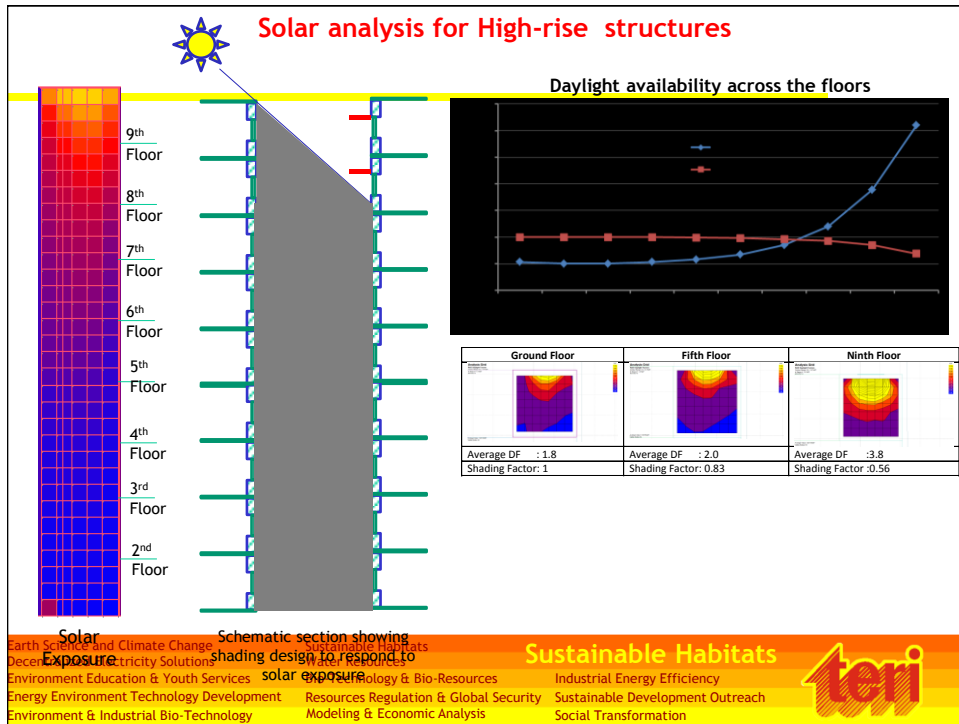
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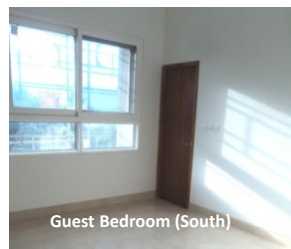
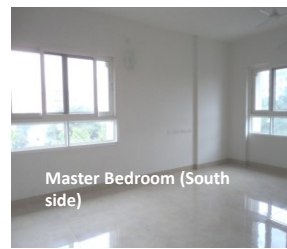
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Photos on Site - 100% living spaces day lit



Criteria 14: Optimize energy performance of buildings within specified comfort limits

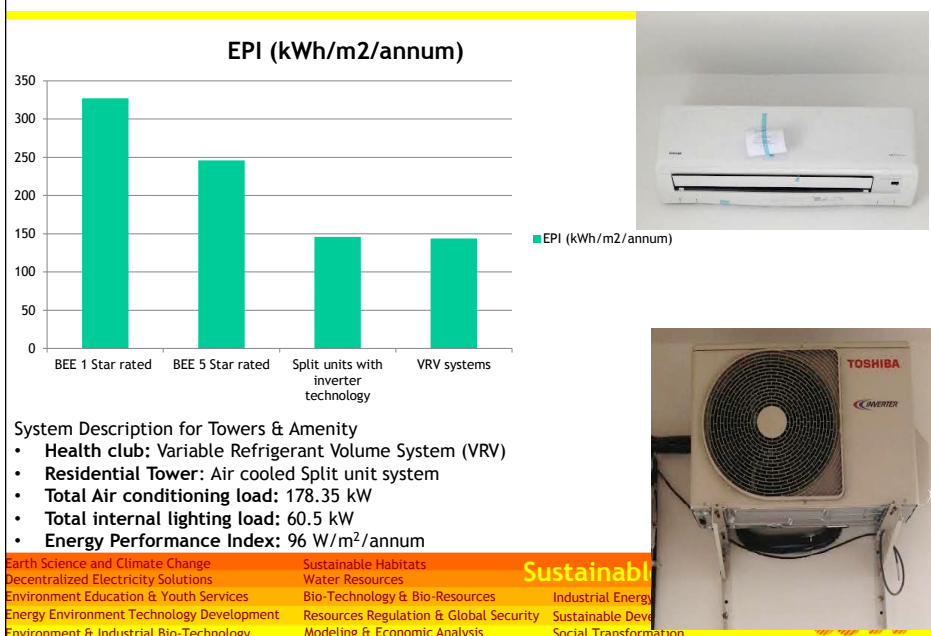
Sl No.	Building Component	U Value Recommended ($\text{W/m}^2\text{K}$)	U Value Recommended ($\text{W/m}^2\text{K}$)	Specification
1	Wall	0.44	1.99 $\text{W/m}^2\text{K}$	230mm fly ash bricks
2	Roof	0.261	0.24 $\text{W/m}^2\text{K}$	170 mm RCC roof with insulation
3	Fenestration	3.3	1.5 $\text{W/m}^2\text{K}$	UPVC Frame (Fenesta make) with double glazed unit 6mm + 12 mm air gap + 6mm Saint Gobain's SKN165 (low E, clear toughened glass with Visible Light Transmission=59% & Solar Factor = 0.32)



SCUDO Cool roof tiles
for 2nd floor terrace



Criteria 14: Optimize energy performance of buildings within specified comfort limits



Criterion 16 :Reduce volume, weight, and construction time by adopting efficient technologies (such as pre-cast systems)

Commitment:

Low-energy products and technologies used in structural non-structural applications

Usage of couplers in reinforcements

Total No. of Coupler used upto LMR 32mm = 415 nos.
Total No. of Coupler used upto LMR 25mm = 8079 nos.

25mm Bar lap length per RM for M30 or M40 = $(1150+900)/2 = 1025\text{mm}$

32mm Bar lap length per RM for M30 or M40 = $(1450+1150)/2 = 1300\text{mm}$

Total Lap length of 25mm bar in that quantity = $(8079 \times 1025)\text{mm} = 8280.975\text{Mtr}$

Total Lap length of 32mm bar in that quantity = $(415 \times 1300)\text{mm} = 539.50\text{Mtr}$

Total weight of 25mm Lap length of that quantity = $(8280.975 \times 3.85)\text{Kg} = 31881.75\text{Kg} = 31.882\text{MT}$

Total weight of 32mm Lap length of that quantity = $(539.5 \times 6.31)\text{Kg} = 3404.245\text{Kg} = 3.404\text{MT}$

So Total weight of Reinforcement Lap = 35.286 MT
Upto LMR total reinforcement used = 1369.64 MT

% savings in Steel = $35.286 / (35.286 + 1369.64) \times 100 = 2.51\%$

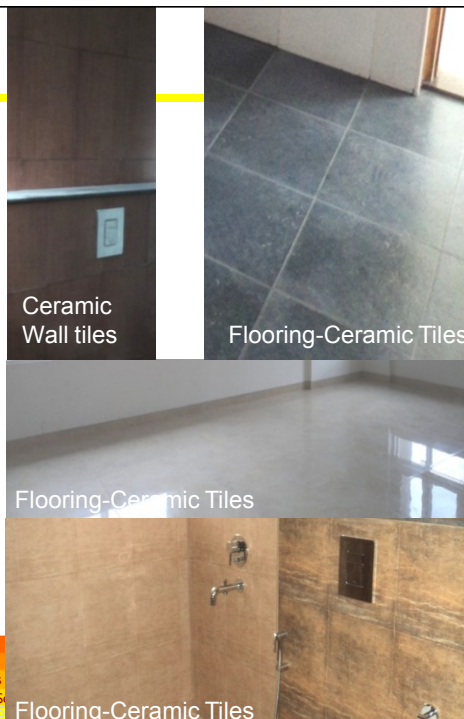
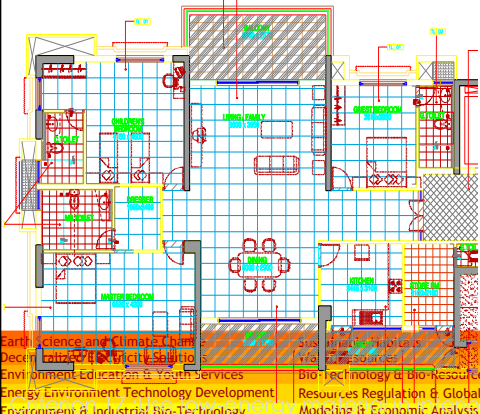


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Criterion 17 :Use low-energy material in interiors

Commitment : A minimum of 70% of the total quantity of all interior finishes and products used in each of the categories mentioned above should be low-energy finishes/materials/products, which minimize wood as a natural resource or utilize industrial waste by using products in any category



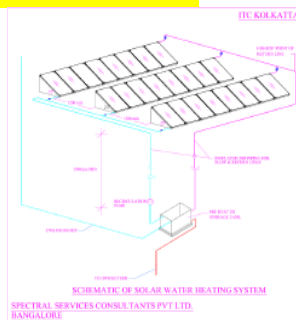
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Criterion 18 Renewable energy utilization

- 250wp multi-crystalline modules with total capacity for 15kWp
- Total area covered = 144 sq.m
- Cost = 17.6 lakhs
- Manufacturer = Tata Power Solar

Calculations:

1. Total internal lighting load is **60.5 kW**
2. Total space conditioning load is **178.3 kW**
3. Total connected load for lighting and space conditioning is **238.8 kW**
4. Rated capacity of proposed solar PV system is **15 kWp**
5. Rated capacity of solar PV system as the percentage of total connected load for lighting and space conditioning is **6.27%**, which is greater than 1%, the mandatory requirement in GRIHA Criterion 18. **(1 point)**
6. Total Energy Requirement Per Year for lighting is **136432.7 KWh**
7. Annual electricity production from solar PV system is **22562 KWh** (RET Screen analysis)
8. Percentage of annual energy requirements of internal lighting consumption provided by solar PV system is **16.53%. (1 points)**



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Criterion 19 Renewable-energy-based hot water system

Specification:

- Flat plate collector- Omega Series-direct natural circulation type
- Capacity = 5000 litres, Manufacturer = Racold
- Total area covered = 89 sq.m, Cost = Rs. 11.36 lakhs

Solar hot water shall be supplied to the master bed room & children bedroom toilet geysers as preheated water.

Energy required for meeting the hot water requirements	
Fuel type	Electricity
Calorific value (kcal/kWh)	861
Conversion efficiency	90%
Combustion efficiency	100%
Annual fuel requirement (MWh)	97.90
Solar water heating system	
Capacity (LPD)	5000.00
Annual energy production(MWh)	69.20
% of hot water from solar water heater	76%
% of annual energy for water heating from solar	71%



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Criterion 20 : Waste-water treatment

Type of treatment system	Moving Bed Biofilm Reactor (MBBR) + Immersed Membrane Bio-Reactor(MBR)
Quantum of treated water generated	40 KLD plant, and the quantum of treated water will be 90 -95%
use/disposal steps	gardening, toilet flushing
Quality checking frequency	Once a month
Disposal and reuse of other by-products	converting it to manure or send out thru registered agency which dispose the sludge
Cost	Rs. 2396575
Vendor	Living Waterefine Technologies

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Modeling & Economic Analysis

TREATMENT SCHEME FLOW

CHART:

BAR SCREEN CHAMBER

EQUALIZATION TANK

MBBR TANK

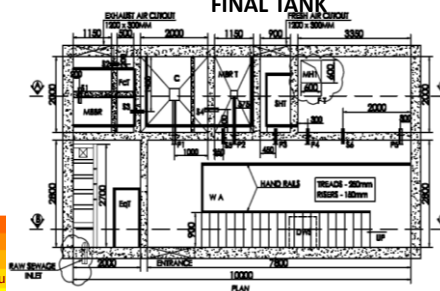
FLOCCULATION TANK

CLARIFIER

IMMERSED MBR

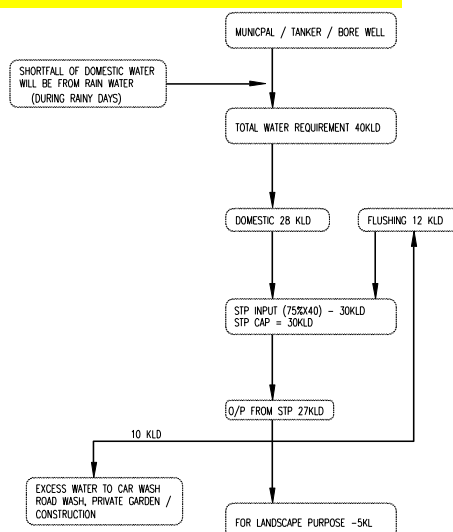
CHLORINATION

FINAL TANK



Criterion 21: Water recycle and reuse (including rainwater)

Water reuse percentage = 67.5 %



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Sustainable Habitats

Industrial Energy Efficiency
Sustainable Development Outreach
Social Transformation



Summary

Location	Kolkata		
Date	2014		
Building Type	Residential apartment		
Site area	4357.86 sq.m	Total built up area	4358.00 sq.m
Construction System	RCC Frame structure and fly ash brick masonry		
Climate	Warm and humid		
Architect	Thomas Architects		
Sustainability consultant	The Energy and Resources Institute		
Sustainability rating system	Green Rating for Integrated Habitat Assessments (GRIHA)		
Energy performance Index	96 kWh/sq.m / annum		
Building Water efficiency	53.8 %		
Occupants' health	Low VOC materials , Daylight, natural ventilation		
Environmental sustainability	Zero ozone depleting substances, fly ash bricks & cement, recycled materials		
Solar PV installation	16.6 % for energy requirement in internal lighting and HVAC		
Solar hot water	71 % annual energy for water heating from solar		
Water reuse	67.5 % from STP and rain water		
Energy Environment Technology Development Environment & Industrial Bio-Technology			
Resources Regulation & Global Security Modeling & Economic Analysis			
Sustainable Development Outreach Social Transformation			
			

Thank you

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